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## Zero commitment: commentary on Zwetsloot et al., and Sherratt and Dainty

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### ABSTRACT

This paper discusses the literature that shows that declaring a zero vision for *everything* bad (including unsafe behaviours, incidents, injuries) does not prevent fatalities or major accidents. In fact, parts of the literature show that a reduction in minor badness *increases* the risk of major accidents and fatalities. This is true in several industries. Two families of explanations are discussed. The first is the concern that declaring a zero vision can reduce operational knowledge. The second is the unsubstantiated assumption that minor injuries and fatalities have the same causal pattern. In general, evidence for or against the utility of a zero vision is dogged by confounding factors (other variables responsible for changes in safety outcomes) and what Giddens called the double hermeneutic, where the results of such studies are only as stable as the attributions the original reporter (e.g. OHS official, case worker) and the subsequent analyst (e.g. researcher) made about a particular event. The paper concludes that in a complex, dynamic, resource-constrained and goal-conflicted world, zero is not an achievable target, but a zero commitment may be worth some encouragement.

### KEYWORDS

Zero vision; triangle; fatality prevention; commitment; target

### Introduction

Scholars who cross swords in the published scientific literature can make for great spectacle and interesting reading. It tends to highlight difference and distinction, however, even on some of the silly, petty nuances. I don't think we gain much by re-reading someone's article, but then in a 'negative photostat' version written by a putative opponent. It can actually obfuscate the interests and stakes we have in common. What we have in common is a shaky, extremely limited empirical basis for any of the claims any of us would like to make about zero vision. One general 'problem' of workplace fatalities is its low total number (although even a low number is too high, we'd agree on that, too). But statistically, it often is noise. And statistical noise is not a basis for strong empirical claims. In addition, claims for its success have been inevitably dogged by confounding factors (i.e. lots of other things could have happened or not happened that help explain the variance). Claims for its uselessness or even its harmfulness, when quantitative, are likely dogged by confounds too. Fortunately, what we now have in common is evidence by way of Sherratt's and Dainty's study, which showed that working on a project subject to a zero policy or program actually appears to slightly increase the likelihood of having a serious life-changing accident or fatality. The authors have done pretty much everything possible to control or check the influence of confounds, and still conduct a real-world study. That is a unique and important contribution. What we have in common, too, is an additional literature (consistent with Sherratt and Dainty) which shows that declaring a zero vision for *everything* bad (including unsafe behaviours, incidents, injuries) does not

prevent fatalities or major accidents. In fact, parts of that literature show that a reduction in minor badness *increases* the risk of major accidents and fatalities. This is true in a range of industries. Explanations for it have congealed around two families. The first is the concern that declaring a zero vision can reduce operational knowledge. The second is the unsubstantiated assumption that minor injuries and fatalities have the same causal pattern. Let's turn to these two now.

### **A zero vision that kills more people**

Declaring a zero vision can reduce operational knowledge, lead to manipulation of incident and injury figures and restrict organizational learning (Anon., 2013; Collins, 2013; Conklin, 2017; Cooter & Luckin, 1997; CSB, 2016; Frederick & Lessin, 2000; Hopkins, 2001, 2006, 2010). When a measure (injuries, incidents) becomes a target (in this case: zero), it stops being a measure. It just becomes a target that needs to be achieved at pretty much all cost. The decline in disclosure, honesty and learning that happens as a result, can increase the probability of major accidents and fatalities. This is consistent with high-reliability organizational orthodoxy: creating climates of psychological safety where getting bad news to the boss is encouraged, is a crucial way to learn about, and manage, operational risk (Dekker, 2016; Dekker & Woods, 2009; Rochlin, 1993; Weick & Sutcliffe, 2007).

Of course, this is an argument that cannot be sustained by argument alone, because what happens in the organization committing to zero harm depends heavily on its cultural proclivities. There are historical examples of organizational cultures that had no tolerance whatsoever for any deviation, failure, incident, or even indication of any possibility of harm, and that actively incentivized assertive, immediate conversations about such indications and a collective responsibility to create meaningful interventions or corrections. This was the case for Japan's 'zero-accident total participation' campaign in the 1960s, which predates the West's Zero Accident Vision (JICOSH, 1964). Pointing and calling out hazards while on dedicated walks (in which workers were instructed exactly how to 'strike a pose with spirit, straighten themselves and then briskly point to the hazard'), with workers taking responsibility for the collective good, worked in that cultural setting. There is, however, no data from that time about whether this helped prevent major incidents or fatalities.

### **Zero incidents/injuries in oil and gas doesn't prevent fatalities**

In his comments on a 1998 gas explosion at an Esso plant in Victoria, which killed two people and injured eight, Hopkins (2001) wrote:

Ironically Esso's safety performance at the time, as measured by its Lost Time injury Frequency Rate, was enviable. The previous year, 1997, had passed without a single lost time injury and Esso Australia had won an industry award for this performance. It had completed five million work hours without a lost time injury to either an employee or contractor. LTI data are thus a measure of how well a company is managing the minor hazards which result in routine injuries; they tell us nothing about how well major hazards are being managed. Moreover, firms normally attend to what is being measured, at the expense of what is not. Thus a focus on LTIs can lead companies to become complacent about their management of major hazards. This is exactly what seems to have happened at Esso (p. 4).

Other petrochemical accidents have elicited the same reflections. For example, the Chemical Safety Board found that the 'BP Texas City explosions was an example of a low-frequency, high-consequence catastrophic accident. Total recordable incident rates and lost time incident rates do not effectively predict a facility's risk for a catastrophic event' (CSB, 2007, p. 202). Another such case seems to be the 2010 Macondo (or Deepwater Horizon) well blowout in the Gulf of Mexico, which killed 11 people and caused the biggest oil spill in the history of humanity. It was preceded by a celebrated six years of injury-free and incident-free performance on the platform (or boat, really) (BP, 2010; Graham et al., 2011). 11 deaths were preceded by zero injuries or incidents. In year-on-year data published by BP over the decade 2005-2015, there were 82 fatalities in total (BP, 2017). Per year, these fatalities do correlate modestly with

recorded incidents ( $r=0.59$ ), though this is not statistically significant ( $p<.051$ ). And it failed to predict Macondo. Achieving a zero target on the small stuff predicted nothing about the big stuff in that case (see also: Conklin, 2017).

### ***Reducing incidents in aviation increases passenger mortality risk***

In 2000, Arnold Barnett and Alexander Wang from MIT published a study that showed that passenger mortality risk is the highest in airlines that report the fewest incidents. This, of course, contra-indicates a commitment to a zero target, since achieving a lower (or zero) number of incidents *increases* the risk that passengers get killed in an air crash. Barnett and Wang used data from 1990 to 1996, a period in which US carriers actually had higher passenger mortality risks than their counterparts elsewhere in the developed world, so it offered a good statistical basis for their analysis and conclusions. Aviation is a bit unique, of course, because crashes tend to kill large numbers of people in one event, and the exact number of fatalities is in part a function of seat occupancy (or the so-called load factor) at the time. The load factor on any particular flight fluctuates with all kinds of factors, none of them having anything to do with the risk of incidents or fatalities:

When [an aircraft] hits a mountain, killing all passengers, the implications about safety are not three times as grave if there were 150 passengers on board rather than 50. And a crash that kills 18 passengers out of 18 should be distinguished from another that kills 18 out of 104. (In the latter case, the high survival rate might reflect excellence in the airline's emergency procedures.) Statistics that weight crashes solely by their numbers of deaths, in other words, are vulnerable to irrelevant fluctuations in the fraction of seats occupied, yet insensitive to salient variations in the fraction of travelers saved (p. 2).

To circumvent this problem, and still have meaningful statistics on the relationship between incidents and fatalities, Barnett and Wang came up with what they called the 'Q-statistic.' This represents passenger-mortality risk per randomly chosen flight. To find Q, the probability of selecting a flight that results in passenger fatalities was multiplied by the average proportion of passengers who are killed aboard such flights (Barnett & Wang, 2000). Using the Q-statistic, they were able to show that the correlation between non-fatal incidents and passenger mortality risk is negative. That means that airlines with fewer incidents pose higher passenger mortality risks. Given the proliferation and sophistication of data gathering in the airline industry, they were able to do more still. As non-fatal incidents became more severe, the correlation with passenger mortality risk became increasingly negative. In other words, the more severe the non-fatal incident suffered by the airline, the less likely it was to subsequently kill its passengers in another one.

### ***In years with fewer incidents, the construction industry suffered more fatalities***

In a study that examined the relationship between workplace fatalities in the construction industry from 1977 to 1991, Saloniemi and Oksanen of Tampere University in Finland found a negative correlation between the number of fatalities suffered in a year, and the incident rate (Saloniemi & Oksanen, 1998). The negative correlation between fatalities and non-fatal incidents in construction was in fact statistically highly significant ( $r=-.82$ ,  $p<.001$ ). In other words, in a year when the industry produced more incidents, a construction worker was much less likely to get killed. And vice versa (Saloniemi & Oksanen, 1998). This again strongly contra-indicates a focus on zero. Fewer incidents, after all, would increase the probability of death.

Whenever occupational accident statistics are used it is necessary to address the question of how 'actual accidents' and accident statistics are related to each other. The definition and outcome of a fatal accident was deemed to be unambiguous, for sure. As for incidents and lost work time, those used for Saloniemi's and Oksanen's analysis here were compiled on the basis of sick leave and compensations granted. We can assume that the practices of granting such leave and compensation inside of a small, centrally governed,

culturally homogeneous country, did not change much from year to year or site to site, and thus would not be responsible for producing much, if any, variance in the results. Even if case management and other ways to negotiate the granting of leave or compensation might have played a role, then this was deemed to be sufficiently constant across the study period. For Finland, the authors were confident that statistical data describing deaths at work avoid at least some of these problems. To correct for any possible influence of the volume of work in construction on the fatality rate, the researchers also ran a correlation between fatalities and economic activity (including the cubic meters under construction) in the given year. The fatality rate *increased* when the volume of work went down. So fatalities were not simply a product of the amount of work being done in a year – in fact, there was a negative correlation.

### Common causes and low/high frequency versus high/low consequence

The idea of a fixed ratio (a stubborn myth in industrial safety, see Besnard & Hollnagel, 2014) inspires people to declare a zero vision for everything, hoping that if they get the small stuff, they get the big stuff too. As Bellamy (2015) put it:

Taking care of the smaller accidents or accident components, like unsafe acts—will reduce the chance of bigger less frequent accident. The idea is that to prevent the severest accidents, use can be made of the knowledge that could be gained from the more numerous smaller accidents and near misses which occur at the base of a triangle of accidents (p. 94).

Such a zero vision for everything only works if there is so-called ‘isomorphism of causal chains’ (to speak with Saloniemi & Oksanen), or an affirmed common-cause hypothesis. If preventing small things is going to prevent big things, then small and big things need to have the same causes. So far, the literature has mostly shown that they don’t (Reason, 1997; Salminen, Saari, Saarela, & Rasanen, 1992; Saloniemi & Oksanen, 1998; Woods, Dekker, Cook, Johannesen, & Sarter, 2010; Wright & van der Schaaf, 2004). Saloniemi and Oksanen (1998) concluded that ‘the[ir] results are consistent with earlier findings which emphasize the specific nature of fatal accidents, with their own distinctive logic and their own causes’ (p. 63). Wright and van der Schaaf (2004) argued that the hypothesis of similarity of causes for fatalities and minor incidents has become confounded with the interdependence of the ratio relationship between severity and frequency. That is, asking whether a low-frequency high-consequence event (e.g. a fatality) has the same causes as a low-consequence high-frequency event (e.g. a minor injury) is different from asking whether there is a fixed ratio between low-consequence high-frequency and low-frequency high-consequence events.

This confounded view of the hypothesis, Wright and van der Schaaf suggested, has led to invalid tests of the hypothesis and thus to erroneous conclusions examined evidence from various studies and concluded that the hypothesis had not been properly understood or tested. Inspired by this, they carried out what they called a ‘proper’ test, with data from UK railways. Incidents were analysed using the confidential incident reporting and analysis system cause taxonomy, which contains 21 causes. The results they produced provided qualified support for the common cause hypothesis for only three out of the 21 types of causes. Only these three had significantly different proportions for the three consequence levels that were investigated: injury & fatality, damage and near miss. In other words, for the data in this study, declaring zero for small stuff would have been effective for bigger stuff only one in seven times. Similarly, in their 1992 study, Salminen and colleagues found conclusive support for the hypothesis of different causation. What hurts workers is not what kills them, and vice versa. So declaring a zero vision for what hurts people won’t do anything to prevent them from dying. In fact, Saloniemi’s and Oksanen’s 1998 study (see above) showed the opposite.

For each such study, of course, others come up with counter-examples. To affirm the belief in the common cause hypothesis, some might propose a connection between worker behavior and workplace culture. For example, Marsh (2013) writes about frequent and trivial behaviors on the one hand and fatalities on the other hand

The two things aren't separate, but interlink and overlap. A good example of an overlap would be the housekeeping on the Piper Alpha oil platform, which was notoriously poor. (Piper Alpha was the North Sea oil platform that exploded in 1988 with the loss of 167 lives). Any meaningful analysis of the poor housekeeping before the accident would have taken the auditor straight to the permit-to-work system ... perhaps considered *the* key cause of the explosion. The permits contained a 'housekeeping put right?' element which, in the light of the poor housekeeping, would have demonstrated clearly a tick-box mentality. ... Something as 'relatively trivial' as housekeeping or PPE compliance could lead to an underlying cause that could be instrumental causing something catastrophic (p. 17).

The idea proffered is that lower-level, 'relatively trivial' behaviours with no immediate consequences are evidence of the existence of a workplace culture (as expressed in sloppy housekeeping, tick-box mentality, inadequate auditing) which both hides and enables more sinister things to brew and explode into disaster. Yet the work permit system used on the platform had actually been awarded a prize not long before the deadly fire. Instead of being obviously inadequate and porous (which only might have become clear after the fact), it was relied on, honoured with awards, and not a pre-accident source of precursor incidents or injuries. In other words, no 'unsafe acts' related to this were formally visible, until the fatalities suddenly blew into view – 167 times over.

A later study (Bellamy, 2015) concluded that lower-severity high-frequency accidents can provide information about the direct and underlying causes of bigger severity more catastrophic accidents – but only within the same hazard category. The study made use of a database of around 23,000 Dutch serious reportable accidents between 1998 and 2009 that were analysed using a barrier model of failure causation (see chap. 9 for more about such models). The results were categorized into 36 hazard specific bow-ties. Bow-ties are visualizations of a central hazardous event, and also depict how such a hazard might be caused and prevented, and how recovery from (and before) negative consequences might be possible. The data from the 23,000 cases were first developed as hazard specific accident triangles to show differences in lethality. Then comparisons of fatal and non-fatal accident causes were carried out, which showed a commonality in causes. Results from this study indicated that, provided accidents from different hazard bow-ties are not mixed together, small severity more frequent accidents can be used to consider the causation and hence prevention of the bigger severity rarer accidents. This moved Bellamy to conclude that the analysis of occupational accidents can help address major one – providing it is restricted to the same hazard type. If true, it would confirm the Heinrich or Bird accident triangle and its proposed relationship between the number of occurrences of more and less serious consequence accidents, and contradict the view that personal and process safety are totally unrelated (Bellamy, 2015).

### ***A double hermeneutic***

Analyzing data from a confidential incident reporting system (in the Wright & van der Schaaf case) or from a database (the Bellamy study), creates what Giddens would call a double hermeneutic (Hermeneutics refers to the meaning and interpretation or understanding of an event or a text). In these studies, an event was interpreted by a reporter as it was being put into a database (the first hermeneutic). Either the reporter was there (i.e. a participant in the event (Wright & van der Schaaf) or not (Bellamy). These reports were subsequently lifted out again and re-interpreted by an analyst who picked certain things from it and assigned them to one or more of the 21 causal categories or 36 bow-ties (the second hermeneutic). Recall Bellamy's conclusion: lower-severity high-frequency accidents *can* provide information about the direct and underlying causes of bigger severity more catastrophic accidents – but *only* if looking within the same hazard category. It was, however, the same analyst who matched accidents of both the lower-level and higher-level consequences with hazard categories. The results of such studies, then, are only as stable as the choices or attributions that the original reporter and the subsequent analyst, respectively, make about a particular event. And the analyst is in some sense already limited to the attributions made by the reporter. Attributions like these are generally not very stable in their relationship to the

sequence of events as seen through the eyes of various participants or observers – and particularly not in hindsight (see Woods et al., 2010).

### A commitment to a commitment

The data above suggest that a declaring a wholesale zero vision – for everything large and small – can at best be a distraction, and at worst a killer. So here's a way in which I've decided to think about a zero commitment. My childhood sweetheart and I have been married for 20 years this year (for more, see Dekker, 2017). We made a commitment, a vow, to keep it that way until the day one of us dies. The commitment is 100% and there are things we do and don't do every day to live up to that commitment. In other words, we are fully committed to a zero vision of divorce. The statistical probability, however, that we are still married to each other on the day either of us dies is currently around 57% (EC, 2017). Yet a 43% chance of divorce doesn't mean we renege on the commitment. On the contrary, it probably means we are conscious of the risks and that we double up on efforts to not have that happen. But that doesn't change anything about the statistical probability, because it is what it is. I like to think of a zero accident vision in that way, too. It's a great, ethical commitment. In a complex, dynamic, resource-constrained and goal-conflicted world, it is not an achievable target. Zero commitment, in other words, is worth striving for. A zero target isn't. Or, put differently, I have zero commitment to a zero target.

### Disclosure statement

No potential conflict of interest was reported by the author.

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